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PALATABILITY OF SUBTERRANEAN CLOVER AND SOME PERENNIAL GRASSES AND LEGUME FORAGE CROPS

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In vivo trials using the method of "trough cafeteria" the palatability or the preference of sheep (Pleven Blackface sheep) to the subterranean clover and to other commonly used perennial forage crops was studied. The observations were done on pure swards of subterranean clover (*Trifolium subterraneum ssp. brachycalicinum*) (cv."Antas"), birdsfoot trefoil (*Lotus corniculatus* L.) (cv. "Targovishte 1"), sainfoin (*Onobrychis viciaefolia* L.) (local population), cocksfoot (*Dactylis glomerata* L.) (cv. "Dabrava") and tall fescue (*Festuca arundinacea* Schreb.) (cv. "Albena"). Results obtained showed that subterranean clover was grazed at 100% and from the legumes sheep prefer most this crop followed by birdsfoot trefoil and sainfoin, and from the grasses – cocksfoot. Subterranean clover consist higher crude protein and lower crude fiber content, thus is a palatable and preferred for grazing by sheep forage crop compared to sainfoin, cocksfoot and tall fescue.
Keywords: birdsfoot trefoil, chemical composition, cocksfoot, palatability, sainfoin, subterranean clover, tall fescue

INTRODUCTION

Taking a different amount of forage by animals is associated with morphological and chemical characteristics of the forage, the digestibility and the method of preparing and eating. It depends on both, the animal-consumer, and factors associated with the forage, most of them controllable, allowing a directing of forage quality (Kirilov,2010). Palatability is one of the main characteristics of forage quality (Emil *et al.*,1997; Julie and Huighe, 1998). It is a relative value that accumulates all forage characetristics associated with the assumption of grasses for grazing (Minson and Bray, 1986; Burnes *et al.*, 1988; Black *et al.*, 1989). With more than one forage, the animals are able to choose and to bring preferences to these forages that have better taste or nutritional value, i.e. which are more palatable. Therefore the inclusion of appropriate grass and legume species for hay and grazing use in the composition of the pastures is important, and it will determine the nutritional composition, consumption of forage and animal productivity (Doyle *at al.*,1993; Komarek *et al.*, 2007; Thomas *et al.*, 2010).

The development of the forage base in the future will continue to be adapted to the needs of the animals to realize their productive potential but also to the permanently emerging climate change (Gornall *et al.*, 2010; Mihovski and Kirilov, 2014; Luscher *et al.*, 2014). In the composition of the pastures will be included adapted to the changed conditions and objectives of the livestock components with greater drought resistance or tolerance to drought (Lelièvre and Volaire, 2009). We will rely on the flexible use of different technological approaches for sustainable management of production of forage for ruminants, including the introduction of new crops.

Subterranean clover (*Trifolium subterraneum* L.) is a widespread component in the pastures and other grasslands of the temperate areas of Central and Northern Europe and America (Pecetti and Piano, 1998, 2002; Kyriazopoulos *et al.*, 2008; Nichols *et al.*, 2012). It is an annual drougth resistant leguminous species with self-seeding capacity thanking to which it presentts in the sward at the beginning and end of vegetation (Yakimova and Yancheva, 1986; Piano *et al.*, 1996; Lemus, 2013).

It is highly permissive is grazing sheep due widespread habitus, on the one hand, and the placement of the growth points near the soil surface, on the other (Nichols *et al.*, 2012). The forage from subterranean clover had high nutritional value and is taken well by the animals in a form of grazing, hay and silage (Ru and Fortune, 2001; Frame, 2005; Nichols *et al.*, 2012). Subterranean clover is preferred forage in the rations of lambs and cows (Stockdale et al., 1992; Mulholland *et al.*,1996).

Studies with subterranean clover as a component of sown pasture swards showed that this crop has practical applicability under the climatic conditions of Bulgaria (Vasilev, 2006, 2009; Vasileva *et al.*, 2011; Vasileva and Vasilev, 2012; Ilieva *et al.* ,2015; Naydenova and Vasileva, 2015, 2016). The subterranean clover sown at an appropriate time in the autumn establishes a uniform stand before the beginning of the permanent cold, spell grows up early in the spring and forms a dense sward.

The aim of this study was to compare the palatability of subterranean clover with that of birdsfoot trefoil, sainfoin,

cocksfoot and tall fescue through grazing of pure grown swards of these crops.

MATERIALS AND METHODS

The experimental work was performed on the experimental field of the Institute of Forage Crops, Pleven, Bulgaria (43º23'N, 24 º34'E, 230 m altitude) in year 2013. Experimental plots (70 m2) were used from field experiment, in which pure swards from subterranean clover (*Trifolium subterraneum ssp. brachycalicinum*) (cv. "Antas"), birdsfoot trefoil (*Lotus corniculatus* L.) (cv. "Targovishte 1"), sainfoin (*Onobrychis viciaefolia* L.) (local population), cocksfoot (*Dactylis glomerata* L.) (cv. "Dabrava") and tall fescue (*Festuca arundinacea* Schreb.) (cv. "Albena") were sown in 2011. No fertilizers and pesticide were applied during the vegetation of the crops.

In *in vivo* experiments with sheep using a method called by us "trough cafeteria" (Gillet et al., 1983) the palatability or preference of sheep during the grazing of the above forage grasses was determined. Thirty sheep number of Pleven Blackface sheep were used to graze the plots in three consecutive days, one hour a day. Grazing was held on 19-21 July 2013. Cells were placed on the swards before grazing and through the difference between the amount before and after grazing, the accepted amounts from each grasses was established. According to data for grazing amount as share - percentage of the quantity available before grazing, the types of grasses were classified. Highest palatability had this crops from which were grazed the most compared to the initial amount available.

In dry plant samples (drying 60ºC) the main chemical composition of the forage was determined - crude protein content (Nx6.25) and crude fiber in Weende method (AOAC, 1990). Experimental data were processed statistically using software SPSS (2012).

RESULTS AND DISCUSSION

Grasses differ in taste or nutritional value. With more than one forage the animals are able to choose and to bring a preference for a more appetizing.

The results obtained from the test for consumption of grasses included in the study are presented in Table 1. They are not treated as absolute values, because they are not measured in units of nutritional value, but only as ranking or ordering of forage.

According to the results obtained, the most appetizing of five studied crops was subterranean clover. It was grazed almost 100%. Individual plant parts from subterranean clover have different digestibility which affects the palatability (McLaren & Doyle 1994). The leaves are more digestible as compared to the stems and leaf stalks, and leaves had the highest content of nitrogen (Stockdale, 1992; Mulholland *et al.*,1996).

After subterranean clover rank cocksfoot, birdsfoot trefoil and sainfoin, and tall fescue ranks last. These data were expected, but they concern the amount of grass rest after cutting of the first cut. Perhaps more delicate leaves of cocksfoot are more palatable and preferred by sheep. Biological feature in the development of cocksfoot is during the vegetation period in the first cut to form generative stems, while in the next, only vegetative stems and leaves. Birdsfoot trefoil showed higher values of preferance by sheep compared to sainfoin.

We believe that a lower palatability of sainfoin was due to the presence of generative stems, which appear in the second cut. Sheep prefer leaf biomass during the grazyng and low-stem plants as well. Advantageously the forage obtained from sainfoin, however, has no risk of causing swelling of the animals (Jacobs and Siddoway, 2007).

The relative low average values of palatability of the forage from cocksfoot and birdsfoot trefoil are similar and probably it was related to the fact that next cut after the first consist only leaves. Leaves had higher palatability and nutritional value than stems. The last place is occupied by tall fescue, due to low leaf-stems ratio. Tall fascue has many advantages, such as drought resistance, longevity, but a relatively low forage quality (Jacobs and Siddoway, 2007; Bingham, 2014), confirmed by our results from the main chemical composition of the forage. The data are shown in Table 2.

Forage biomass from birdsfoot trefoil and subterranean clover had the highest crude protein content. As a rule the crude fiber content is higher during the summer, due to high temperatures that promote accumulation of structural carbohydrates in the plants (Wilson *et al.*, 1991; Stockdale, 1992; Mulholland *et al.*,1996). In our study crude fiber content in the forage, with

Table 1: Comparative data for the palatability during the grazing of some forage crops by sheep

Crops	Dry matter before grazing (%)	Dry matter after grazing (%)	Before grazing (kg/ha)	Grazed grass (kg/ha)	Grazed grass (%)	
Subclover	21.63	-	55.4	55.4	100.00	(1)
Birdsfoot trefoil	30.70	40.20	265.6	209.6	78.92	(3)
Sainfoin	29.46	41.18	196.8	136.7	69.46	(4)
Cocksfoot	29.02	38.78	193.9	165.4	85.30	(2)
Tall fescue	31.42	35.85	154.9	103.4	66.75	(5)
SE (P=0.05)	1.72	1.16	34.4	26.2	5.98	

the exception of subterranean clover and cocksfoot varied within narrow limits.

Table 2: Crude protein and crude fiber content in the forage biomass

Crops	Crude protein	Crude fiber
	% of dry matter	
Subclover	16.04	21.96
Birdsfoot trefoil	16.46	25.65
Sainfoin	14.86	25.44
Cocksfoot	9.88	27.18
Tall fescue	9.68	25.84
SE (P=0.05)	1.49	0.86

The lowest (21.96%) values were recorded for subterranean clover. Assigned to the values of other legumes studied (birdsfoot trefoil and sainfoin), crude fiber content in subterranean clover was over 3.5% lower, which is probably a prerequisite for its better palatability or preferably by sheep.

***Conclusions*:** When comparing palatability of subterranean clover, birdsfoot trefoil, sainfoin, cocksfoot and tall fescue, it was found that from legumes, sheep prefer most subterranean clover, followed by birdsfoot trefoil and sainfoin, and from the grasses - cocksfoot. Aftergrass from cocksfoot has by 27.8% greater palatability than the tall fescue. Subterranean clover is a palatable and preferred for grazing by sheep forage crop because of lower crude fiber and higher crude protein content as compared to the same characteristics in sainfoin, cocksfoot and tall fescue.

REFERENCES

AOAC 1990. Official Methods of Analysis (15th ed.). Association of Official Analytical Chemists, Arlington, Va. K. Herlich (ed.). Arlington, Va., USA.

Available et: http://www.internationalgrasslands.org/files/igc/publications/1997/2-17-097.pdf

Bingham, Troy, J. 2014. Plant and Animal Performance in Tall Fescue and Tall Fescue/Legume Pastures. All Graduate Theses and Dissertations. Paper 2769. Utah State University.

Black, J.L., W.F. Colebrook, S.G. Gherardi and P.A. Kennedy. 1989. Diet selection and the effect of palatability on voluntary feed intake by sheep. 139-151. In: Proc 50th Minnesota Nutr.Conf. Minn.Agr.Ext.Ser., St Paul.

Burnes, J.C., D.H. Timothy, R.D. Mochrie and D.S. Fisher. 1988. Relative grazing preference of Panicum germplasm from three taxa. Agron. J. 80: 574-579.

Doyle, P.T., M. Grimm and A.N. Thompson. 1993. Grazing for pasture and sheep management in the annual pasture zone. In 'Pasture management technology for the 21st Century'. (Eds. D.R. Kemp, D.L. Michalk), pp. 71–90.

Emil, J.C., Ghesquiere, M., Traineaau, R., Jadas-Hecart, J. and Mousset, C. 1997. Evaluation de la valuer alimentarire de genotypes de fetuque eleveee obtenus par diffeerents strategies d'amelioration. Fourrage.151: 373-387.

Frame, J. 2005. Forage legumes for temperate grasslands.Rome: Food and Agriculture Organization of the United Nations. Plymouth UK: Science Publishers Inc. 320 p.

Gillet, M., C. Noel and J. Jadas-Hecart. 1983. La cafeteria d'auges, method d'etude de l'appetibilite des fourrages. Agronomie. 3: 817-882.

Gornall, J., R. Betts, E. Burke, R. Clark, L. Camp, K. Willett and A. Wiltshire. 2010. Implications of climate change for agricultural productivity in the early twenty-first century. Philosophical Transactions of the Royal Society B 365, 2973–2989.

Ilieva, A., V. Vasileva and A. Katova. 2015. The effect of mixed planting of birdsfoot trefoil, sainfoin, subterranean clover, and tall fescue on nodulation, and nitrate reductase activity in shoots. J. Glob. Agric. Ecology.3. 4: 222-228.

Jacobs, J. and J. Siddoway. 2007. Tame Pasture Grass and Legume Species and Grazing Guidelines, Plant Materials Technical Note Number MT-63 December 2007.

Julie, B. and C. Huighe. 1988. Variabilite genetique pour la digestibilite de la jucerne: relation avec ia production de matiere seche et la proportion de feuilles. Fourrages.154: 261-268.

Kirilov A. (2006). Variation in some qualitative chracteristics of fresh and preserved forages. Thesis Doctor of Science, p. 262.

Komarek, P., P. Nerušil, A. Kohoutek and V. Odstrčilova. 2007. The effect of repeted direct sowing of grass-legume seed mixtures into grasslands on forage production and quality. Grassl Sci. Europe. 12: 39-42.

Kyriazopoulos, A. P., E. M. Abraham, Z.M. Pariss and A. S. Nastis. 2008. Herbage production and nutritive value of *Dactylis glomerata* L. and *Trifolium subterraneum* L. alone and in mixtures. Options Méditer.79: 211 - 214.

Lelièvre, F. and F. Volaire. 2009. Current and Potential Development of Perennial Grasses in Rainfed Mediterranean Farming Systems. Crop Science. 49. 6: 2371-2378.

Lemus, R. 2013. Self-reseeding Potential of Annual Clovers. Forage News, Mississippi State University, volume 6, issue 1, 1-2.

Luscher, A., I. Mueller-Harvey, J.F. Soussana, R.M. Rees and J.L. Peyraud. 2014. Potential of legume-based grassland–livestock systems in Europe: a review. Grass Forage Sci.69: 206-228.

McLaren, S.E. and P.T. Doyle. 1994. Dry matter digestibility of subterranean clover during senescence and after death. Proc. Aust. Soc. Anim. Prod. 20: 221-224.

Mihovski, Ts. and A. Kirilov. 2014. State of ruminant animals' stockbreeding and the respective forage base in Bulgaria. Aktualni poznatky v pestovani, slechteni, ochrane rostlin a zpracovani produktu, "Uroda 12/2014, vedecka priloha casopisu", eds. Badalikova B. and Bartlova J., ISSN 0139-6013, 105-110.

Minson, D.J. and R.A. Bray. 1986. Voluntary intake and *in vivo* digestibility by sheep of five lines of Cenchrus ciliaris selected on the basis of preference rating. Grass Forage Sci.41. 1: 47-52.

Mulholland, J.G., K.S. Nandra, G.H. Scott, A.W. Jones and N.E. Coombes. 1996. Nutritive value of subterranean clover in a temperate environment. Australian J. Experi. Agri. 36: 803-814.

Naydenova, Y. and V. Vasileva. 2015. Forage quality analysis of perennial legumes - subterranean clover mixtures. Sci. Intern. 3: 113-120.

Naydenova, Y. and V. Vasileva. 2016. Analysis of Forage Quality of Grass Mixtures – Perennial Grasses with Subterranean Clover. J. basic appl. Res.2: 534-540

Nichols, P.G.H., C.K. Revell, A.W. Humphries, J.H. Howie, E.J. Hall, G.A. Sandral, K. Ghamkhar and C.A. Harris. 2012. Temperate pasture legumes in Australia – their history, current use and future prospects. Crop Pasture Sci. 63: 691–725.

Pecetti, L. and E. Piano. 1998. Leaf size variation in subterranean clover *(Trifolium subterraneum* L. sensu lato). Genetic Resources and Crop Evolution. 45. 2: 161-165.

Pecetti, L. & Piano, E. Gen. Res. Crop Evolution .45: 161.

Pecetti, L. and E. Piano. 2002. Variation of morphological and adaptive traits in subterranean clover populations from Sardinia (Italy). Genetic Resources and Crop Evolution. 49. 2: 189-197.

Piano, E., L. Pecetti and A. M. Carroni. 1996. Climatic adaptation in subterranean clover populations. Euphytica. 92. 1-2: 39-44.

Ru, Y. I. and J. A. Fortune. 2001. Seed yield and nutritive value of dry, mature subterranean clover (*Trifolium subterraneum* L.). Australian J. Experi. Agri. 41: 169-175.

SPSS 2012 SPSS Version 20.0. SPSS Inc. 233 S. Wacker Drive Chicago Illinois

Stockdale, C.R. 1992. The nutritive value of subterranean clover herbage grown under irrigation in Northern Victoria. Austra. J. Agri. Res. 43: 1265-1280.

Thomas, D.T., J.T.B. Milton, C.K. Revell, M.A. Ewing, R.A. Dynes, K. Murray and D.R. Lindsay. 2010. Preference of sheep among annual legumes is more closely related to plant nutritive characteristics as plants mature. Animal Production Sci. 50: 114–123.

Vasilev, E. 2006. Productivity of subterranean clover (*Tr. subterraneum* L.) in pasture mixtures with some perennial grasses for the conditions of Central North Bulgaria. Plant Sci. 43: 149-152.

Vasilev, E. 2009. Chemical composition of subclovers forage (*Tr. subterraneum* L.) and crude protein yield in pasture mixtures with grasses. J. Mount. Agri. Balkans.12: 329-341.

Vasileva, V. and E. Vasilev. 2012. Dry mass yield from some pasture mixtures with subterranean clover (*Trifolium subterraneum* L.). J. Mount. Agri. Balkans.15:1024-1033.

Vasileva, V., E. Vasilev and M. Athar. 2011. Nodulation and root establishment of two clover species grown in pasture mixtures with wheatgrass. FUUAST J. Biology.1: 1-4.

Wilson, J. R., B. Deinum and F.M. Engels. 1991. Temperature effects on anatomy and digestibility of leaf and stem of tropical and temperate forage species. Netherlands J. Agri. Sci.39: 31-48.

Yakimova, Y. and H. Yancheva. 1986. Phytocenological and ecological characteristics of some annual clovers in Strandja region. Plant Sci. 23: 47-53.